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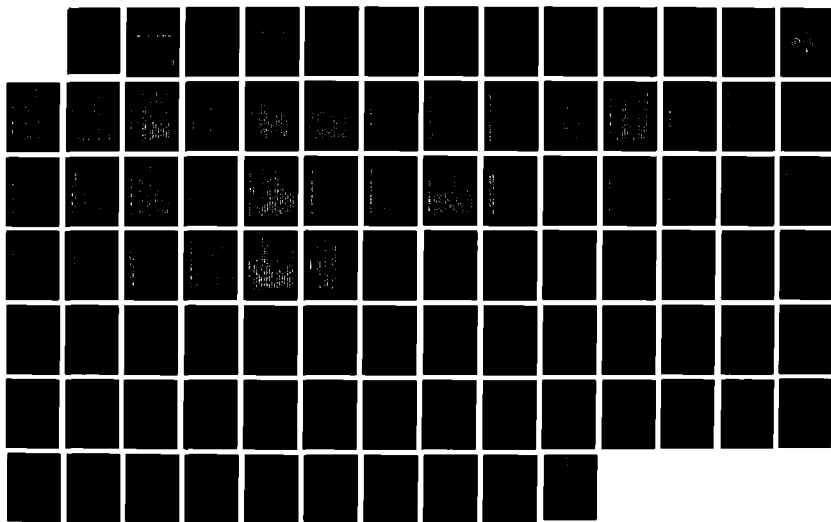
DSMC (DEFENSE SYSTEMS MANAGEMENT COLLEGE) CALS  
(COMPUTER-AIDED ACQUISITION) EVALUATION RESEARCH  
CORP ARLINGTON VA NOV 88

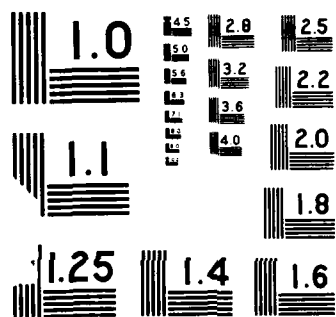
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# DSMC CALS BRIEFING

-PROGRAM MANAGER COURSE

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NOVEMBER 1988

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This material contains vugraphs and suggested narrative for a one hour module on the Computer-aided Acquisition and Logistic Support (CALS) initiative for the Program Management Course (PMC) at the Defense Systems Management College at Ft. Belvoir, VA. It is designed to give an understanding of the nature and scope of the DoD CALS initiative; its application to weapon programs; and the benefits expected from CALS. The outline is what is CALS?; why CALS?; where are we going?; how and when will we get there?; major system/equipment implementation; technical aspects; issues; and summary. Most of the material was derived from the 1988 OSD CALS Report to the Appropriation Committee for the House of Representatives and drafts of the CALS Program Implementation Guide (HDBK-59). The material in the PMC is also contained in the DSMC CALS Briefing for the Management of Acquisition Logistics Course. (SIX) - 3					
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# DSMC CALS BRIEFING

PROGRAM MANAGER COURSE  
NOVEMBER 1988

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DSMC CALS BRIEFING MODULE

PROGRAM MANAGER COURSE (PMC)

(30 - 60 MINUTES)

1. BACKGROUND
2. LEARNING OBJECTIVES, ETC.
3. SUGGESTED VUGRAPH SEQUENCE
4. VUGRAPHS
5. NARRATIVE

## BACKGROUND

The attached graphics and narrative were prepared for use by the Defense Systems Management College in a two hour segment on CAD/CAM/CALS in the Program Managers Course (PMC). The graphics and narrative are selectively used by the instructor for the CALS portion (normally 45 to 50 minutes) of this segment. Learning objectives and outcomes, student reading assignments prior to the lecture, student handouts, and optional reading are also attached. Students at DSMC do not normally receive copies of the vugraphs.

This material is being released to the services and industry for use as they see fit in association with CALS implementation. The materials may be used in whole or in part since many organizations feel it desirable to add or use material specifically oriented to their command or company. While a suggested sequence is included, other sequences of similar material has been successfully used. The PMC material can also be combined with material from the longer (90 minutes to two hours) material prepared for the Management of Acquisition Logisitcs Course (MALC) module. Some of the material is common to both modules.

The material is taken primarily from the 1988 CALS Report to Congress and the draft DoD CALS Implementation Guide. The OSD expects to update the DSMC course material on a continuing basis since CALS will change significantly over time. The potential user of this material should take this changing picture into account in planning to use any or all of this material, which was prepared by the Evaluation Research Corporation.

November 1988

DRAFT

TECHNICAL MANAGEMENT DEPARTMENT

Subj: DoD CALS Initiative Presentation for PMC Course

Objectives:

- o To provide an understanding of the scope and nature of the DoD CALS initiative, its application to DoD programs in the near term, and the possible benefits to DoD program management.

Desired Learning Outcome: Each student should receive and understanding of:

- o The nature and scope of the DoD CALS initiative
- o It's application to weapon programs
- o Benefits expected from CALS
- o Where to go for additional information

Assignments:

- o August 1988 CALS policy memo (attached) SCAN. 5 minutes
- o Executive Summary of 1988 CALS Repot to Congress. (Attached) SCAN. 10 minutes

Preparation Time Required: 15 minutes

Optional Reading:

- o 1988 CALS Report to Congress (attached)
- o Paper: Initial Graphics Exchange Specification (IGES) Capability Development for SSN-21 (attached)
- o Draft DoD CALS Program Implementation Guide, library.
- o Air Force Tech Order Management System - Final Report, library
- o DLA CALS 1988 Implementation Plan, library.

Where to go for Additional Information:

- o Industry CALS Task Force (Attached)
- o DoD CALS Steering Group (Attached)
- o CALS Bulletin Board (Attached)

**SUGGESTED PMC CALS**

**MODULE VUGRAPH SEQUENCE**

## VUGRAPH TITLES

<b>VUGRAPH NUMBER</b>	<b>TITLE</b>	<b>NARRATIVE PAGE NO.</b>
1	COVER. . . . .	1
2	WEAPON SYSTEM AND EQUIPMENT APPLICATION POLICY . . . . .	2
3	OUTLINE . . . . .	3
4	WHAT IS CALS . . . . .	4
5	WHAT IS CALS - CHANGE OVER TIME . . . . .	7
6	SCOPE . . . . .	8
7	BENEFITS - SUMMARY . . . . .	9
8	BENEFITS - ILS . . . . .	10
9	BENEFITS - F-16 . . . . .	11
10	TIME SAVING CONCURRENCY . . . . .	12
11	CALS STRATEGY . . . . .	13
12	PHASED IMPLEMENTATION . . . . .	14
13	MANAGEMENT STRUCTURE . . . . .	16
14	INDUSTRY AS A PARTNER . . . . .	17
15	FUNDING . . . . .	19
16	MAJOR MILESTONES . . . . .	21
17	APPLICATION POLICY. . . . .	22
18	IMPLEMENTATION GUIDE. . . . .	23
19	DECISION TEMPLATE . . . . .	25
20	WEAPON SYSTEM CONTRACT - 1990s. . . . .	26
21 & 22	CALS MAJOR THRUSTS - WHERE ARE WE GOING . . .	28
23	IMPORTANT IMPLEMENTATION CONSIDERATIONS . . .	29
24	WEAPON PROGRAM EXAMPLES . . . . .	30

VUGRAPH NUMBER	TITLE	NARRATIVE PAGE NO.
25	V-22 CALS DEMONSTRATIONS . . . . .	31
26	GROWTH IN BENEFITS . . . . .	32
27	TECHNICAL ASPECTS . . . . .	33
28	INITIAL CALS STANDARDS. . . . .	34
29	STANDARDS IN DEVELOPMENT . . . . .	36
30	TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS . . . . .	37
31	CALS ARCHITECTURE AND INFRASTRUCTURE IMPLEMENTATION . . . . .	38
32	CALS STANDARDS IMPLEMENTATION STEPS . . . . .	39
33	ISSUES . . . . .	41
34	SUMMARY - BENEFITS. . . . .	43
35	CONCLUSION. . . . .	44

# TOPICAL AGENDA

## SEMI-ANNUAL CALS OFFICE STAFF MEETING

- o How do we establish "need to know" at Skyline of front office activities, Re: What is Generic Risk Assessment; Don's role in architecture and frameworks.
- o Transfer of Marion's duties: Conferences; Budget; Moving Documents; Floors; Windows; Latrines.
- o FY 1989 NIST Statement of Work status.
- o FY 1990 NIST Statement of Work: Tasks, deliverables, involvement of office personnel.
- o FY 1989 QRTO Task Status Report: What are the tasks, why, how do they fit with CALS FY 89/90 goals, status of efforts, timing of deliverables-re MIL-HDBK-59 schedule. Data protection, incentives, generic risk assessment, and CITIS.
- o FY 1990 QRTO Task Support Needs: Electronics, Concurrent Engineering, Technical Manuals.
- o Data Dictionaries: who is doing what to whom; IRDS follow-up; who has lead; Skyline support needed?
- o Phase I.2 Status Report, deadlines for inputs, MIL-STD-1840A, what is document list.
- o MIL-HDBK-59 Schedule, deadlines for inputs from ISG Task Groups, deadlines for conversion to specific language.
- o CALS EXPO 89 Agenda.
- o Acquisition Task Group: what's happening; will any language be available in time for MIL-HDBK-59; DARS/FARS; how can we accelerate.
- o Schedule of CALS phases, sub-phases, sub-sub-phases and associated documents, change notices, and amendments.
- o Where is the plan for how all this stuff: TSC, LMI, NIST, PDES, generic risk assessment, incentives, architecture, frameworks, etc. all fit together. We must be generating enormous duplication of effort due to lack of communications. Is there a better way than the shotgun approach.
- o Possibility of greater service involvement in support of ISG activities.
- o Improving communications between Skyline and front office. (1) What are the mechanisms for internal visibility of CALS team activities, contractor tasking, deliverables, and deadlines. (2) Calendar maintenance, including faster turn-around. (3) Better match of resources to tasks; how do we plan/prioritize to avoid schedule slips of Phase I.2. (4) How does Skyline get input into support tasking?
- o Need for better tracking of service initiatives: updates to service CALS Implementation Plans; e.g., DLA implementation of SGML in 1992; are they using 28001 tag set; what about DTDs.

- o Travel (Do we really need to go on any more "wave the flag" trips. I am declining trips that might effect changes in people's actions to attend conferences where the same old crew is presenting the same old stuff. Don's input).



# **DOD INITIATIVES IN COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT**

**MARYA BRAUNSTEIN  
DEFENSE SYSTEMS MANAGEMENT COLLEGE**

# **CALS IMPLEMENTATION POLICY**

**(DEPSECDEF MEMO FY1988)**

- **Systems now in FSD or production**
  - **Review cost saving and quality opportunities from changing to digital delivery or access**
- **Systems entering development after Sep 1988**
  - **Require proposals for CALS data delivery or access**

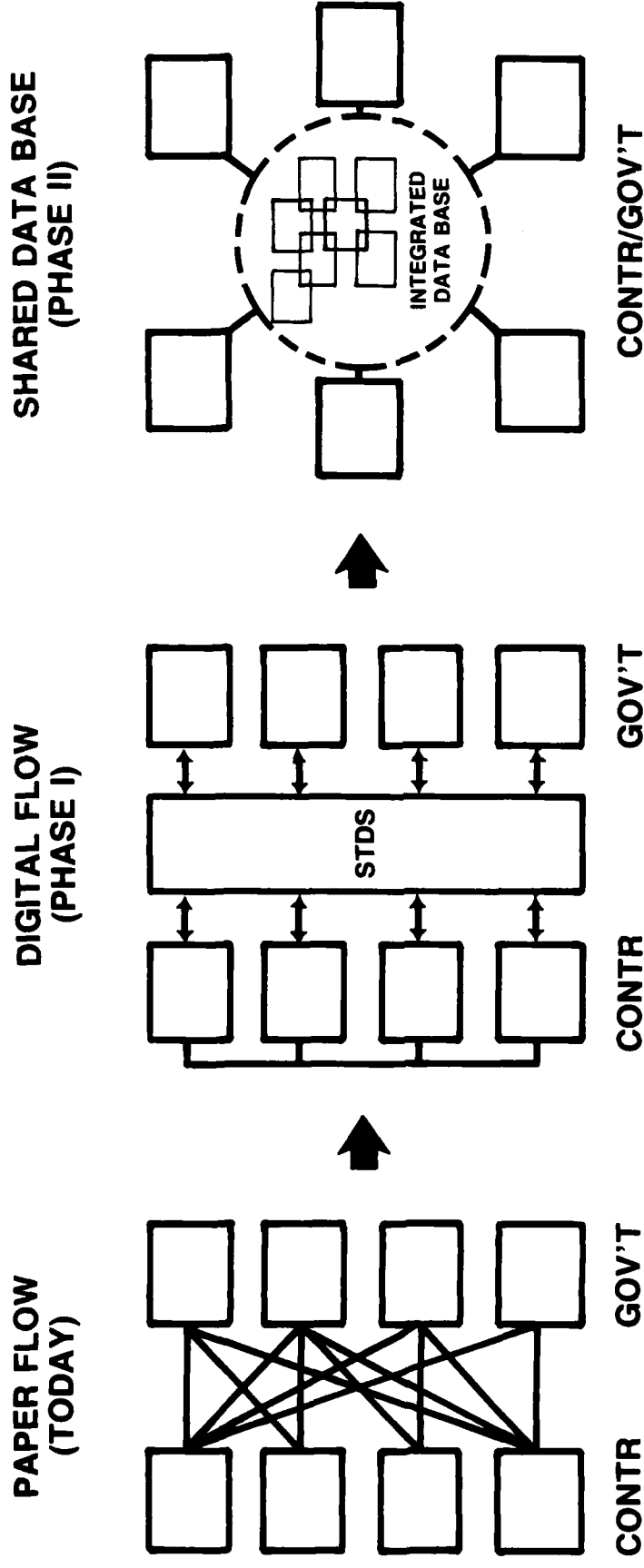
# OUTLINE

- **What is CALS?**
- **Why CALS?**
- **Where are we going?**
- **How and when will we get there?**
- **Major system/equipment implementation**
- **Technical aspects**
- **Issues**
- **Summary**

# WHAT IS CALS?

- **Integration strategy**
- **Bridge “islands of automation” in DOD and industry design and logistics processes**
- **Gain benefits of a highly automated and integrated system**
  - **Reduce paper/eliminate redundant tasks and data**
  - **Improve timeliness and accuracy of information**
  - **Design more supportable weapon systems**
  - **Reduce costs**

# WHAT IS CALS?



- INTEGRATION PROGRAM
- TRANSITION TO "NEAR PAPERLESS" DESIGN, MANUFACTURING, SUPPORT
- GAIN BENEFITS OF A HIGHLY AUTOMATED AND INTEGRATED SYSTEM

# SCOPE

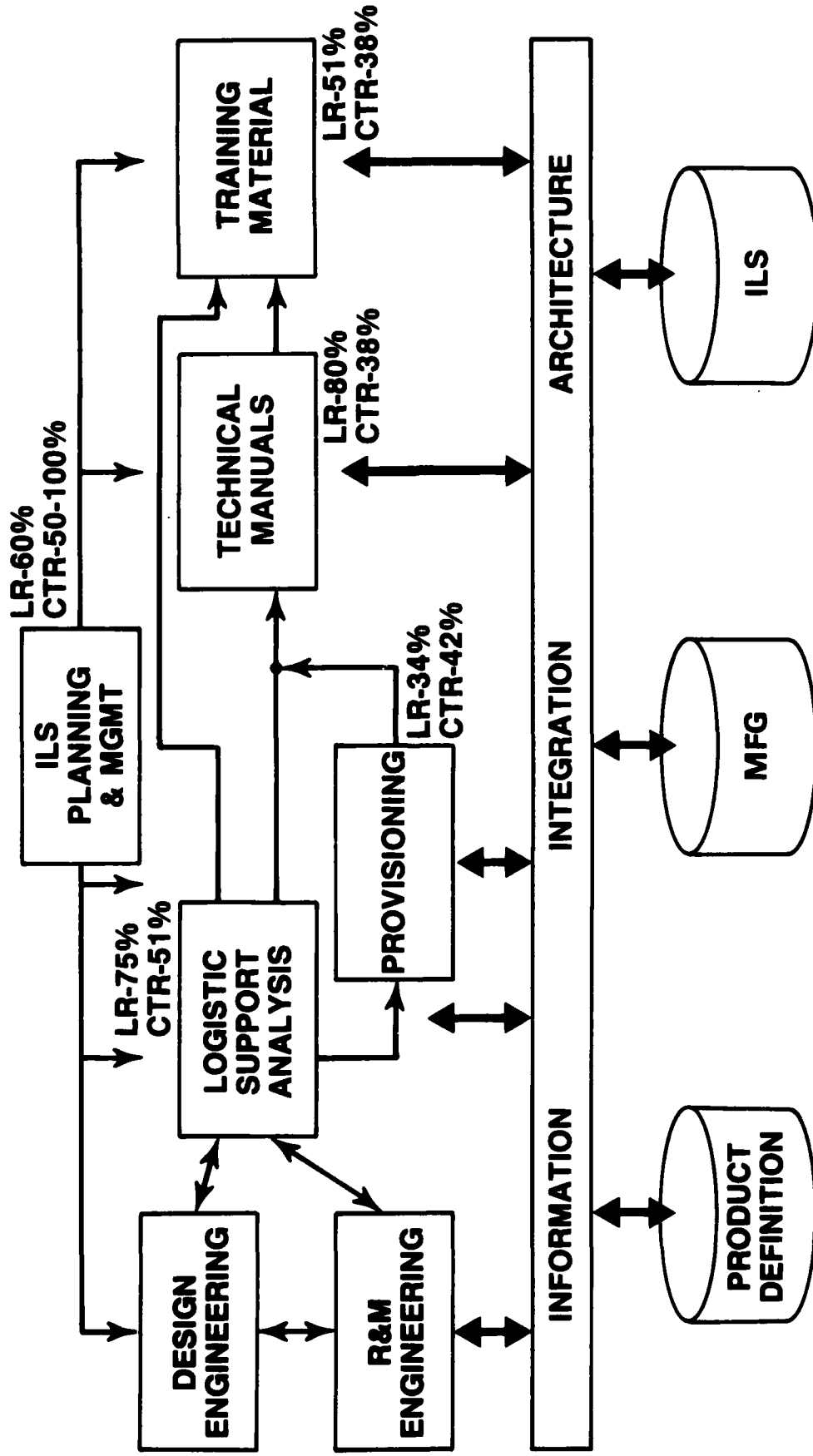
- Technical data base definition and access
  - 1. Product definition data base
  - 2. Integrated support data base
- Digital data interchange
  - \*1. Product definition data
  - \*2. LSA/LSAR
  - \*3. Technical manuals
  - 4. Training materials
  - 5. Technical plans and reports
  - 6. Operational feedback data
- Integration of processes
  - \*1. R&M integration in CAD/CAE

\*Major initial areas of emphasis

# **WHY CALS? EXPECTED BENEFITS**

- **Digital preparation and delivery**
  - **Elimination of redundant data**
  - **20-30% expected savings in TM automation of authoring**
  - **35% improvement in troubleshooting accuracy**
- **\$135M potential AF annual savings in tech manuals changes**
- **Integrated data bases**
  - **20-35% savings in ILS**
  - **Opportunity to impact 5-10% of acquisition cost**
- **Redesigned processes**
  - **New ways of doing business**
  - **20% estimated savings over weapon system life cycle**

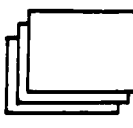


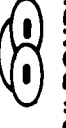
# WHY CALS?



**LR - LABOR REDUCTIONS  
CTR - CYCLE TIME  
REDUCTIONS**

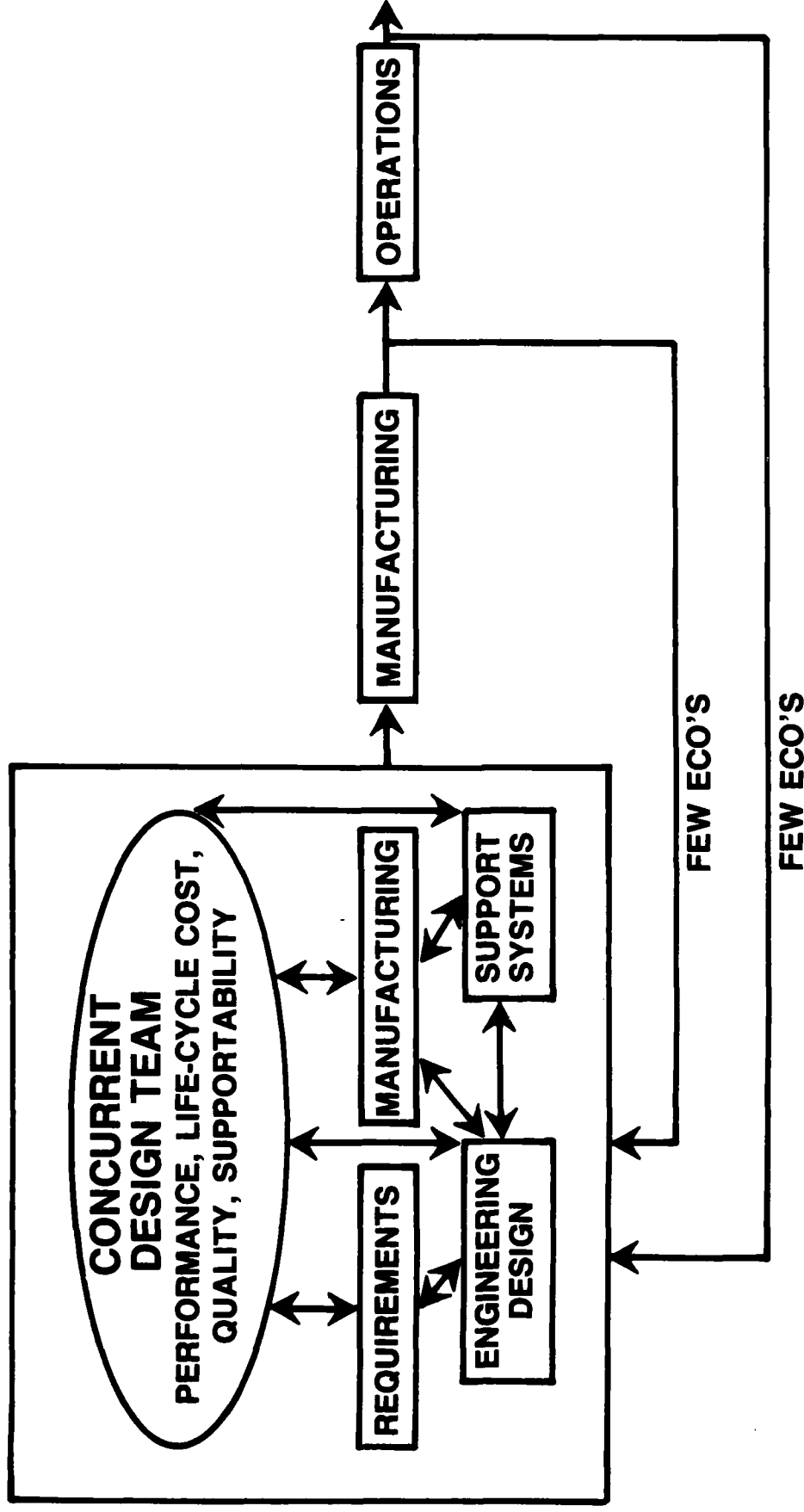
**"INTEGRATED PROCESSES -  
INTEGRATED INFORMATION"**

# F-16 WEAPON SYSTEM STORAGE AND DISTRIBUTION OF TECH MANUALS: COST COMPARISON (1987 PRICES)

	# OF DISCS/ PAPER REQUIRED PER SET	UNIT COST	PRODUCTION COST PER SET	SUBTOTAL PER SET	DELIVERY COST** (UPS)	TOTAL
 PAGES	750,000	\$21,300	—	\$21,300	\$750 (TRUCKING COST)	\$22,050
 CARTRIDGE DISK	1,098	\$70	\$1,235	\$78,095	\$240	\$78,135
 CD-ROM	39	\$275	\$859*	\$966	\$4	\$870
 12" DOUBLE SIDED WORM	12	\$400	\$180	\$4,980	\$12	\$4,992

\* PRODUCTION COST BASED ON 100 SETS  
\*\* CALCULATED FOR 500 MILES

# NEW WAYS OF DOING BUSINESS



- "GET IT RIGHT THE FIRST TIME"
- COMPRESSION OF DESIGN AND DEVELOPMENT TIME
- LOWEST LIFE-CYCLE COSTS

# **CALS STRATEGY**

- **Phased implementation**
  - **ADP modernization (DOD, industry)**
  - **Technology demonstrations, prototypes**
  - **Lead weapons system programs**
  - **Routine contractual implementation**
- **Establish unified DOD interface with industry**
  - **Develop “core” of interface stds, functional specs**
  - **Use by services as common point of departure in contracts**

# **CALS IMPLEMENTATION**

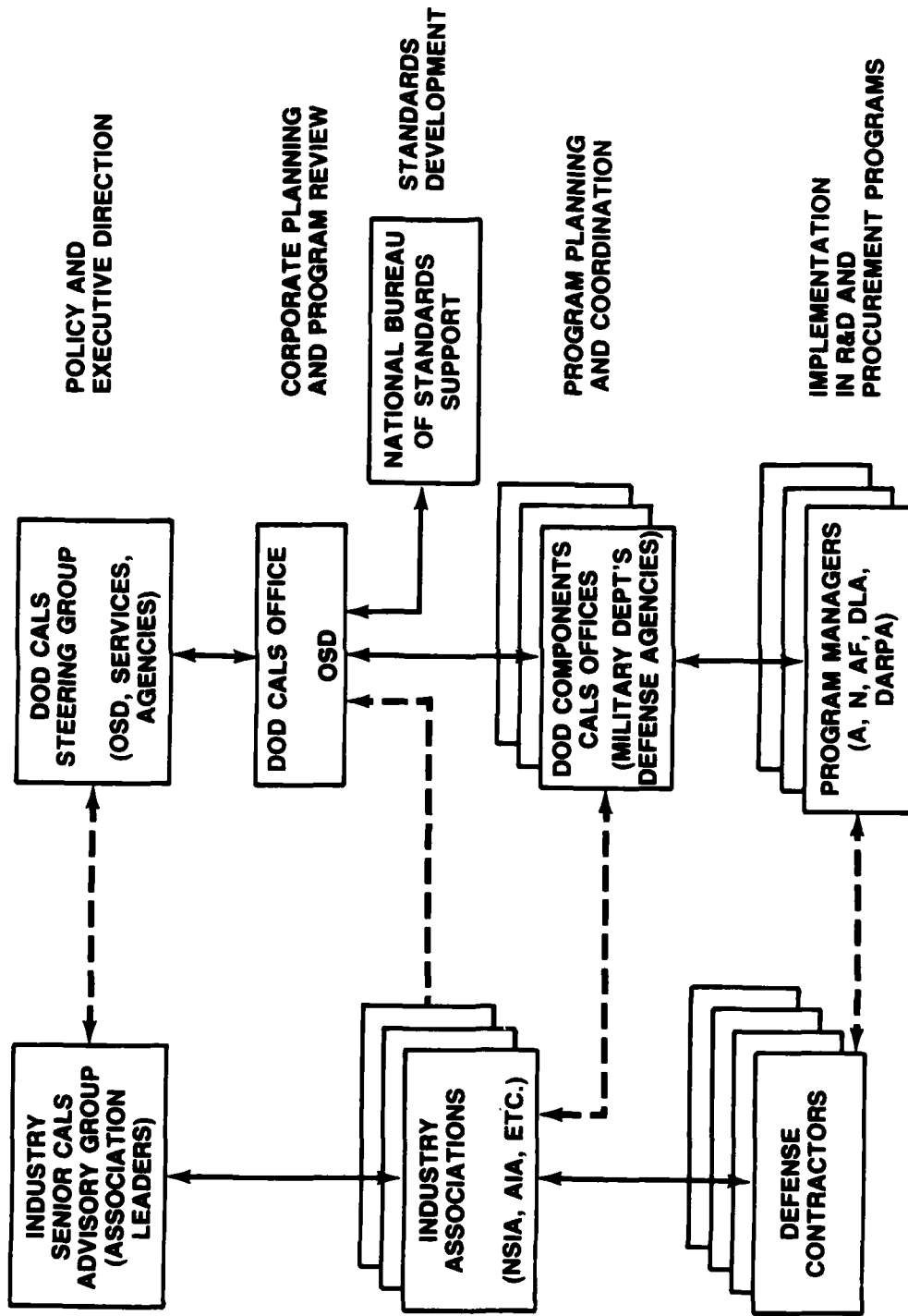
## **Phase I**

- **Focus on**
- **A few major logistics applications**
- **Available technology, standards**
- **Primarily “records transfer” environment**

## **Phase II**

- **Focus on**
- **Wider range of design, mfg, logistics applications**
- **More advanced technology, standards**
- **Centroid is advanced product data models**
- **Primarily “online access” environment**

# MANAGEMENT



# **CALS — INDUSTRY IS A PARTNER**

- Industry is cooperating
  - Industry advisory group
  - Industry steering group
  - PDES cooperative
- Industry impact
  - Large investment
  - Prime-prime, prime-sub-vendor links
  - Essential to stay competitive
- Preferred mode is for DOD to adopt a common industry-developed approach

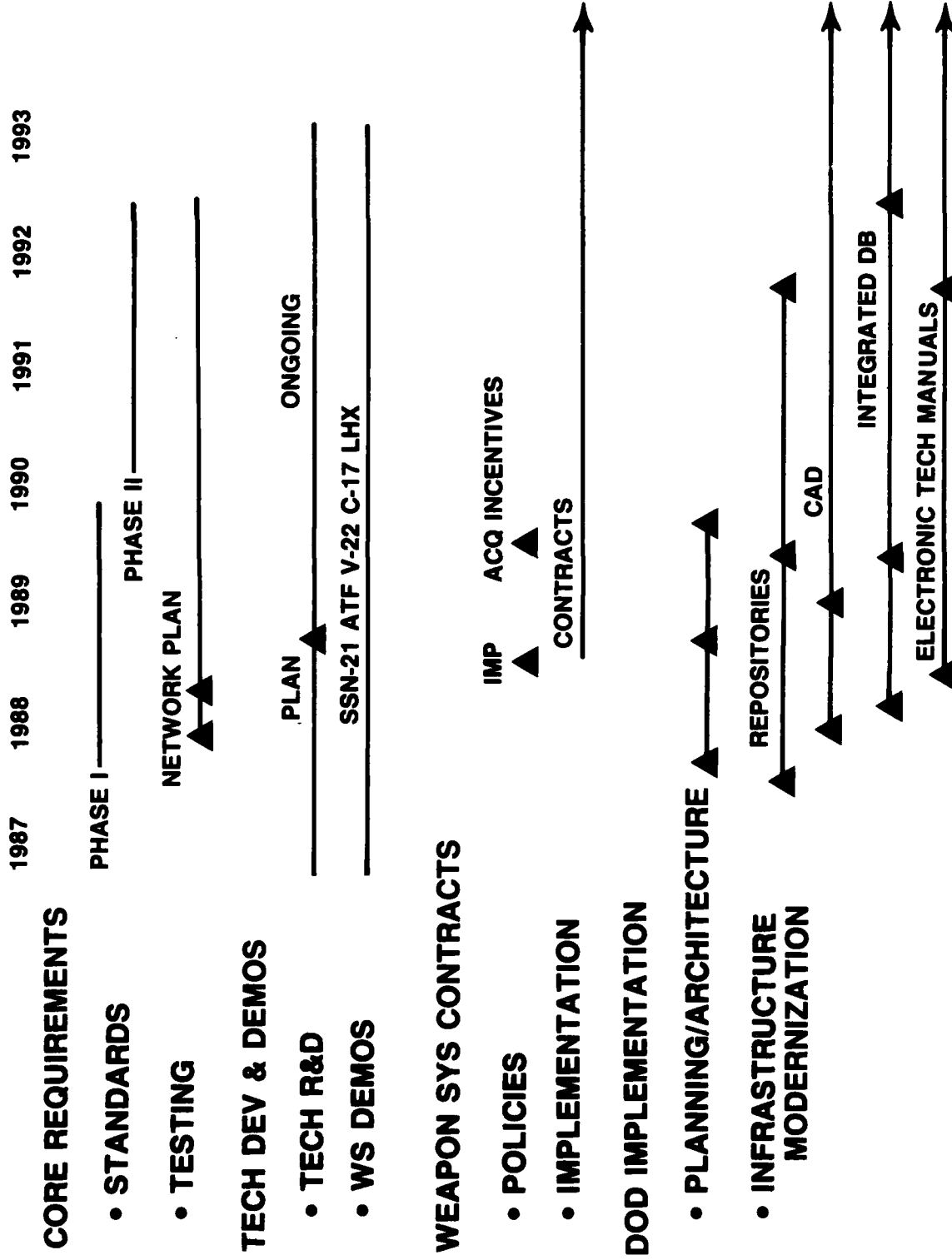
# DOD FUNDING FOR CALS

Direct investment	FY87	FY88	FY89
OSD	13.6M	13.0M	13.0M
DOD	173.7M	223.8M	120.0M*

CALS funds leverage multi-billion dollar plans for modernization in DOD and industry

\* Reduction due to removal of 3 large infrastructure programs from CALS oversight

# CALS SCHEDULE OBJECTIVES



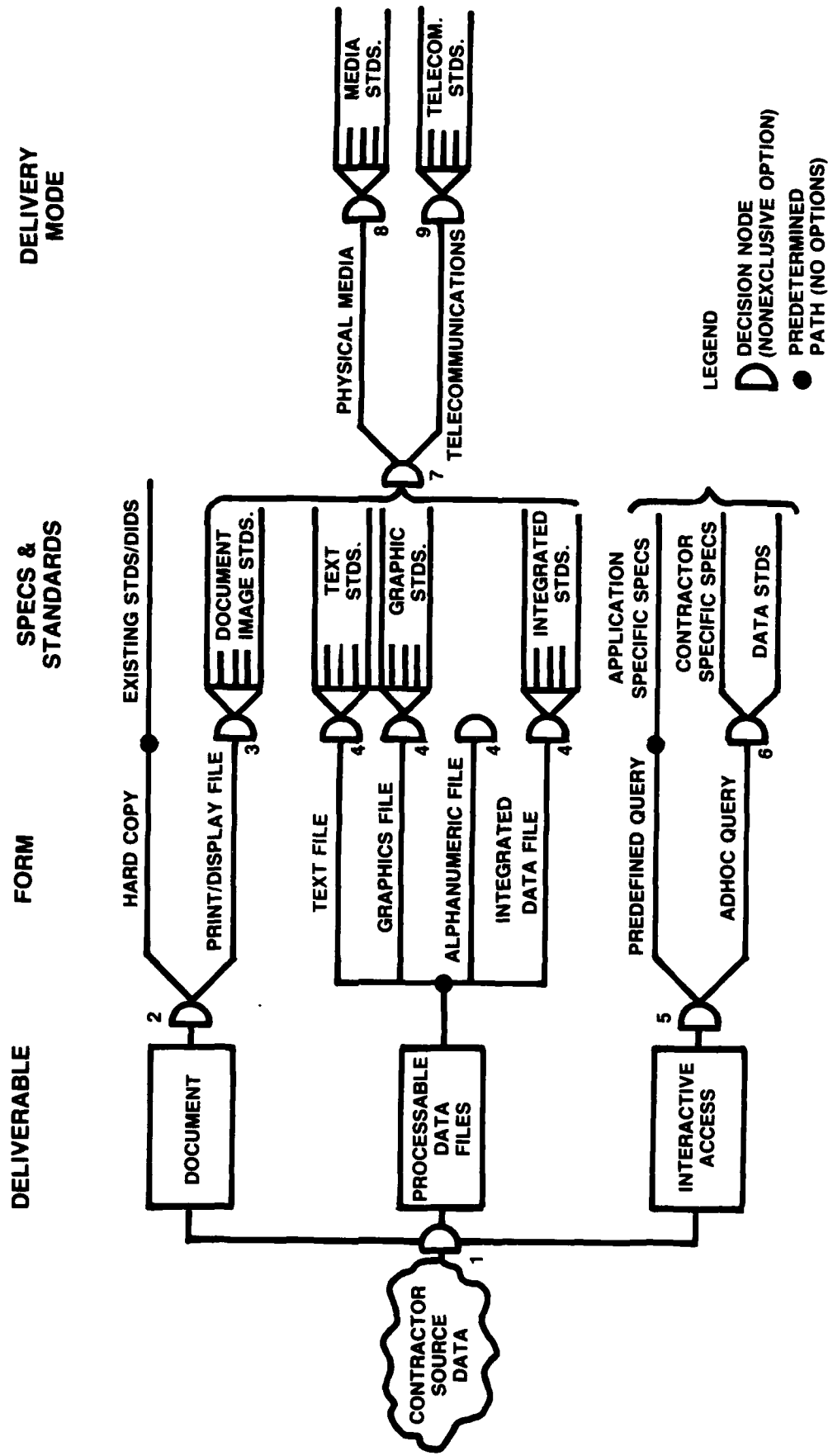
# **CALS IMPLEMENTARY POLICY (DRAFT DEPSECDEF MEMO)**

- **Systems now in FSD or production**
  - **Review cost saving and quality opportunities from changing to digital delivery or access**
- **Systems entering development after Sep 1988**
  - **Require proposals for CALS data delivery or access**
- **Infrastructure systems**
  - **Program resources for systems to receive and use digital data**
  - **Configure or adapt systems to support CALS standards**
- **Acquisition policy**
  - **USD(A) will issue further guidance on contracting, incentives, subcontractors, funding mechanisms.**

# **CALS IMPLEMENTATION GUIDE**

- **Guidance for digital deliverables**
  - **Decision trees, criteria, examples**
- **Functional requirements**  
**Model SOW and tailored MIL-STD language**
- **Initial coverage (Apr 88)**
  - **Engineering drawings**
  - **Technical manuals**
  - **Online LSAR**
  - **Security**
  - **R&M integration with CAD/CAE**

# DECISION TEMPLATE FOR ACQUISITION OF DIGITAL DELIVERABLES

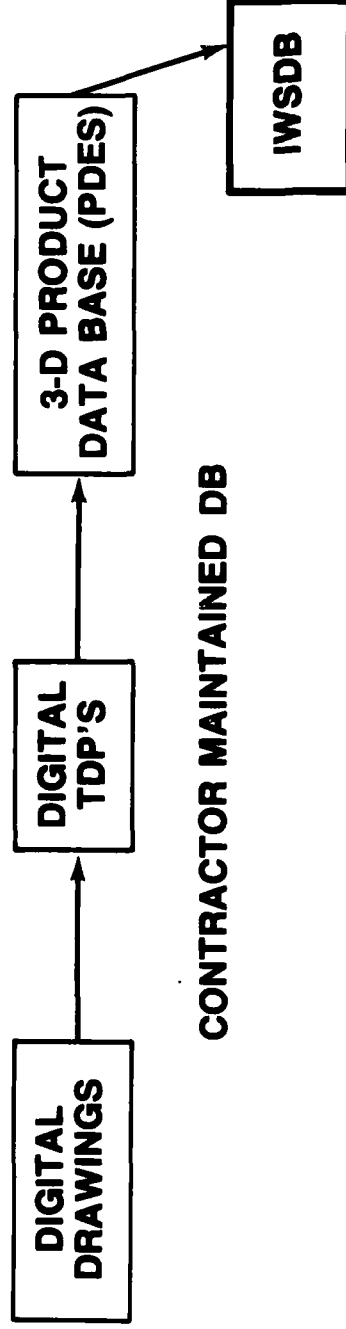


# **WEAPON SYSTEM CONTRACT - 1990s**

- **Emphasis of CALS in source selection criteria**
- **Movement toward functional requirements integration**
  - **Integration of R&M with CAE**
  - **Automated generation of logistics data products**
  - **Integrated CAE/CAM/CALS data base**
- **Movement toward paperless delivery of logistics data products**
  - **Product definition data**
  - **Technical manuals**
  - **LSA record data**
  - **Training materials**
  - **ILS management**

# CALS: WHERE ARE WE GOING?

## • PRODUCT DEFINITION DATA



## CONTRACTOR MAINTAINED DB

## • INTEGRATED SUPPORT DATA BASE

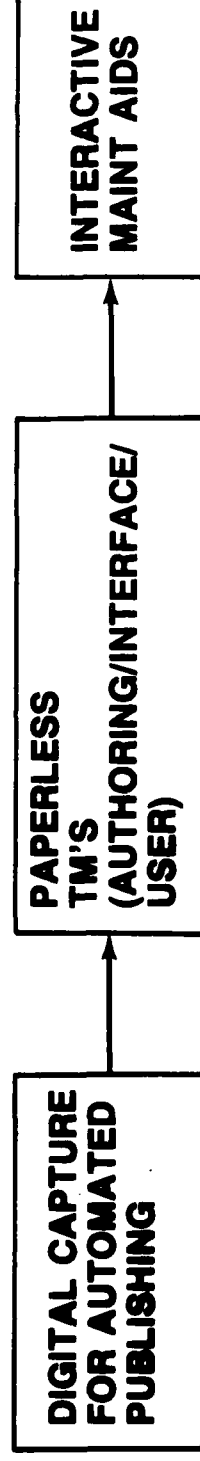


ON LINE REVIEW & APPROVALS, PROVISIONING, ORDERING

# CALS: WHERE ARE WE GOING?

## APPLICATIONS

- TECHNICAL MANUALS



## ELECTRONIC PRESENTATION OF EXPERT SYSTEM TROUBLESHOOTING ROUTINES

- SPARES ACQUISITION
- TRAINING MATERIALS
- OTHERS

# IMPLEMENTATION POLICY

## Important considerations

- Recognize that integration is not an “all or nothing” proposition
  - See how far bidders can go
- Online access will be limited to selected contractor data bases
  - Principal targets are deliverables for review and approval
- Routine delivery of digital data will be paced by availability of validated standards and government receiving systems
  - Define requirements now for data to be delivered in the 1990’s
  - Seek flexible alternatives to hedge risks

## Bottom line

- Keep CALS target in sight, but do what makes sense for each program
- CALS lead programs are good examples

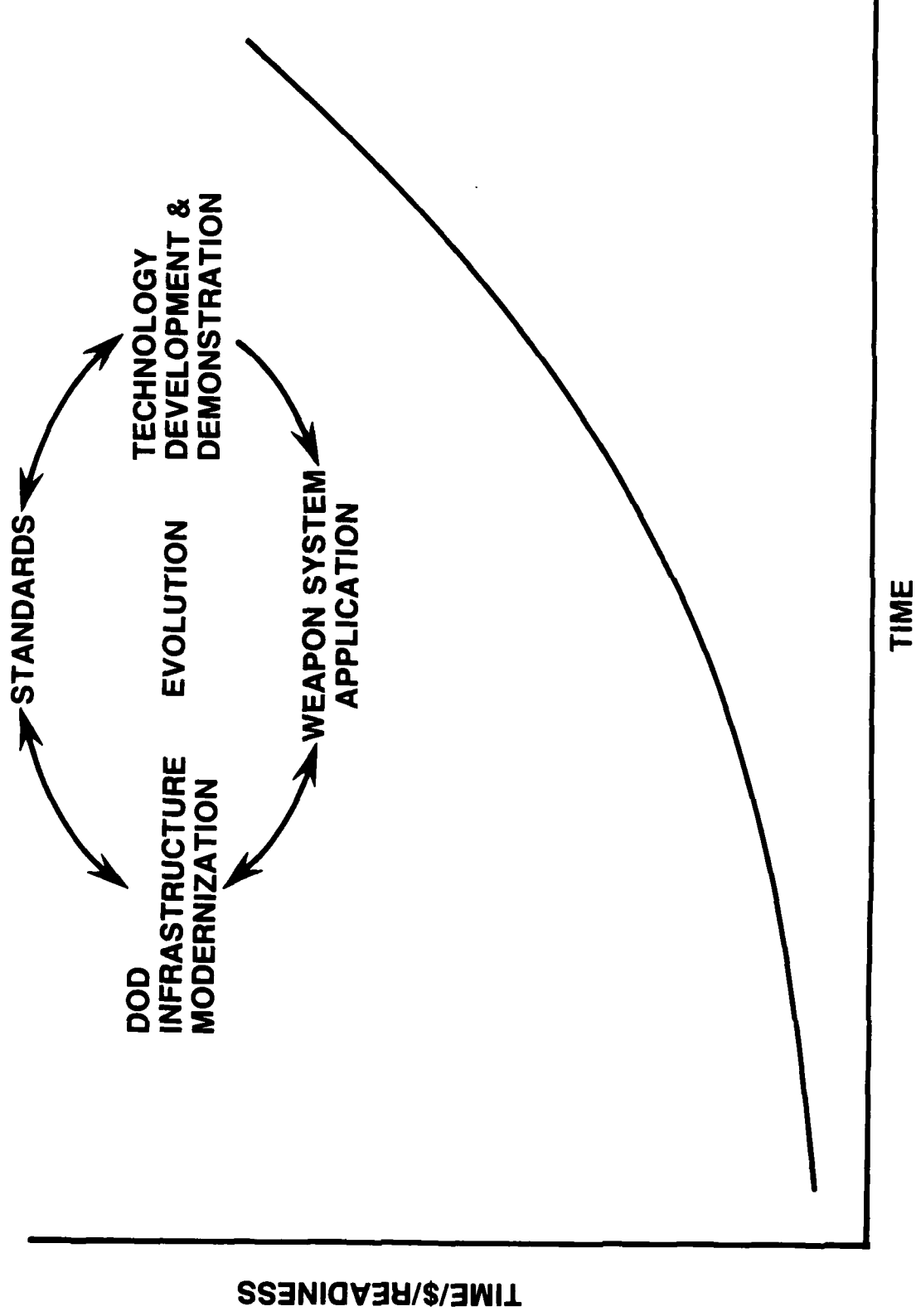
# WEAPON PROGRAM IMPLEMENTATION EXAMPLES

PROGRAM	ACQUISITION PHASE	# OF CONTRACTORS OR CONTRACTING TEAMS	RFP REQUESTS	DELIVERY DATE
ATF	ADVANCED DEVELOPMENT	2	DEFINE DIGITAL DELIVERY MODES	1989
LHX	ADVANCED DEVELOPMENT	2	DEFINE DIGITAL DELIVERY FOR TECH MANUALS AND LOGISTIC DATA	1990
JVX	FULL-SCALE DEVELOPMENT	2	REVIEW AF AND NAVY PROGRAMS AND DEFINE APPROACH R&M LINK TO CAE/CAD	(1988)
SSN-21	FULL-SCALE DEVELOPMENT	2	IMPLEMENT DIGITAL DELIVERY	1988-1990

## V-22 CALS DEMONSTRATIONS

<b>Title</b>	<b>Description</b>	<b>Expected Completion date</b>
<b>CAD</b>	Interchange data between Bell/Boeing	Sep 87
<b>LSA/LSAR</b>	Automated database - three contractor interchange - government access	Oct 87
<b>Provisioning</b>	Automated H Sheet delivery on line access (ASO pilot)	Oct 87
<b>SML</b>	On line access - interfaced to LSAR	Oct 87
<b>Publications</b>	Prompted authoring - link to LSAR	May 88
<b>Task and Skill Analysis</b>	Automated link to LSAR - G Sheet access on line (MIL-STD 1379)	Feb 88
<b>Training Courseware</b>	Prompted authoring - link to LSAR and pubs	May 88
<b>SERDS</b>	Tri-service format - link to LSAR on line access	May 87
<b>LORA</b>	Link to LSAR on line access	Jan 88
<b>Engine Monitoring System</b>	Diagnostics and health reporting	Sep 88
<b>Operational Feedback</b>	Operational feedback data to improve engineering and logistics design	Sep 89

# GROWTH IN PROGRAM BENEFITS



# **TECHNICAL ASPECTS**

- **Standards**
- **Technology and demonstration projects**
- **CALS architecture and infrastructure implementation**
- **Testing**

# INITIAL CALS STANDARDS

- MIL-STD-1840A, "Automated Interchange of Technical Information," Dec 1987
- MIL-D-28000, "Digital Representation for Communications of Product Data: IGES Application Subsets," Dec 1987
- MIL-M-28001, "Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text," Feb 1988
- MIL-D-CGM, "Digital Representation for Communication of Illustration Data: CGM Application Profile," now in coordination.
- MIL-R-RASTER, "Requirements for Raster Graphics Representation in Binary Format," now in coordination.

# **STANDARDS IN DEVELOPMENT**

- **Office Document Architecture and Interchange Format (ODA/ODIF)**
- **Standard Page Description Language (SPDL)**
- **Information Resource Dictionary Systems (IRDS)**
- **Structured Query Language (SQL)**
- **Production Data Exchange Specification (PDES)**

# TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS

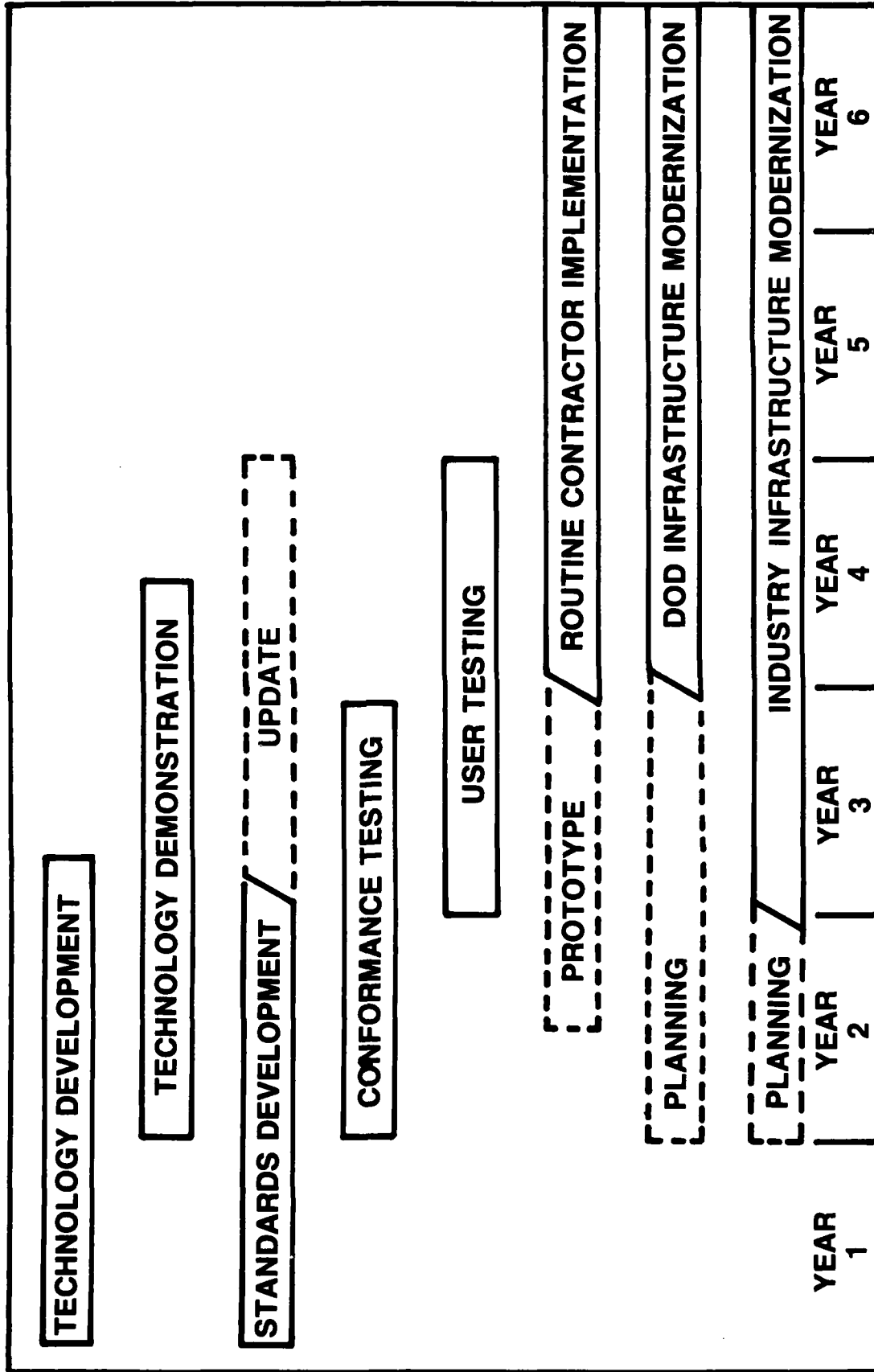
AREA	87	88	89	90	91	92
ADVANCED PRODUCT DATA TECHNOLOGY		ISS (AF) GMAP (AF) IDS (AF) MCM (N)	DGIS (DLA) EIS (AF) MEP (AF)		RAMP (N)	
ELECTRONIC TM/TOS AND TRAINING MATERIALS		MEIDS (N)	SMDP (DLA) AIM (N) ITDS (AF) CATIS (N)		CBAT (N)	IMIS (AF)
INTEGRATION OF SUPPORTABILITY WITH DESIGN	MLCAD (AF)	GBD (AF)	IDSS (N)			
PARTS DATA ACCESS		GFB (DLA)	MIDS (A)			

# CALS ARCHITECTURE AND INFRASTRUCTURE IMPLEMENTATION

AREA	87	88	89	90	91	92	93
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ARCHITECTURE PLANNING	MI0/ATI (AF) NSTIS (N)					LSMP (DLA)	ACALS (A)
ENGINEERING DATA REPOSITORIES AND PRODUCT DATA	DSREDS/EDCARS (A/AF) MEDALS (DLA) TD/CMS (A) MPCASS (DLA)		EDMICS (N/DLA)		CAD-2 (N)		
AUTOMATED PUBLISHING AND PAPERLESS TM SYSTEMS	AFTOMS/ ATOS (AF) IIS (AF)		NAPS (N) NPODS (N)				

# CALS STANDARDS IMPLEMENTATION STEPS



# **CALS IMPLEMENTATION ISSUES**

- **Rights to data**
- **Security, privacy, export controls**
- **Profit structure, investment incentives**
- **Delivery, verification, acceptance**
- **Legal liability**
- **Co-operative production (other nations)**
- **DAR, FAR revisions**
- **ADP acquisition process**

# **CALS BENEFITS**

## **From industry's perspective**

- **Productivity gains through automation and integration**
- **Less effort in design/manufacturing transition**
- **Less redundancy in data preparation**
- **Paperless interchange among primes, subs**
- **Quality improvements**
- **Product design**
- **Data**

## **From government's perspective**

- **Productivity gains**
  - **Acquisition**
  - **Operation**
- **Improved readiness**
- **Shortened lead times**
- **Timely, accurate, accessible data**

# **SUMMARY**

- **DOD is committed to achieving major gains through automation**
- **The CALS recommended strategy will be implemented**
- **Will require concerted planning and investment by both DOD and industry**

DRAFT

NARRATIVE FOR DSMC PMC COURSE CALS MODULE

11 October 1988

DRAFT

VUGRAPH 1 - COVER

This presentation covers the status of the Computer-aided Acquisition and Logistic Support (CALS) Program. CALS is an effort to reduce paper - and get out of the manual mode of data generation.

CALS is a high priority initiative within the Department of Defense (DOD). It was started in 1985 based on recommendations from a high level joint DOD and industry task force. CALS will have a heavy impact on other DoD program management, the DoD logistics infrastructure, and the commercial as well as the defense segment of industry.

CALS will increase productivity in DoD and industry - but the bottom line for DoD is really improved readiness and tools in the hands of the GI.

CALS is a classic example of a management strategy to:

- (1) achieve synergism
- (2) combine parts such that the sum of the whole is greater than the sum of the individual parts, or
- (3) kill more than one bird with one stone.
- (4) leverage

Much of the material we will cover is contained in your handout material.

## VUGRAPH 2 - WEAPON SYSTEM AND EQUIPMENT APPLICATION POLICY

The CALS program is about to impact heavily on Defense major system program management as shown by this excerpt from a memo recently signed by Deputy Secretary of Defense Taft. A copy of this memo is in your handouts. The policy essentially says that OSD will not force backfitting on programs now in FSD or production, but CALS will be applied to all other major weapon system developments after September 1, 1988. The services will apply their own judgment on application to less than major systems.

### VUGRAPH 3 - OUTLINE

This chart shows the general outline this presentation will follow. We will basically address the what, why, where, how, and when of CALS, then briefly review it's implementation on major systems and equipments, discuss the technical aspects of CALS and cover some issues.

#### VUGRAPH 4 - WHAT IS CALS? (Continued)

- o Increased responsiveness of the industrial base by development of integrated design and manufacturing capabilities and by Industry networking to build and support weapon systems based on digital product descriptions.

Here in a nutshell is what we are trying to do. CALS is an integration program. We want to transition to a near paperless environment for design, manufacturing, and support of weapon systems, thereby gaining the productivity and quality benefits that will come from a highly automated and integrated mode of operation. Today's environment consists of stand-alone functional application areas, both in industry and DoD. To some extent those functional applications have been automated over the past 10 years with the result that we have islands of automation that cannot easily communicate with one another. That is true both within and between prime contractor's plants as well as between DoD and Industry. The flow of information today is primarily in hard copy form.

#### EXAMPLES OF ISLANDS OF AUTOMATION

The CALS 1987 Report to Congress cited some 52 different major logistics related automation projects within DoD in the areas of data repositories, printing and publishing systems, authoring systems, data base management and information processing systems, communication access and data distribution, presentation and maintenance aids, automated procurement and parts control systems, CAD/CAM and related tools, and system integration and architecture.

#### TOO MUCH PAPER

The DoD logistics system is currently hindered by immense amounts of paper. To illustrate this fact, DoD has some 200 million drawings - with each at best on an 80 column aperture card.

#### VUGRAPH 4 - WHAT IS CALS?

Widespread use of computer-aided design and engineering (CAD/CAE) has created a new environment where product description data is becoming available in digital form to support a wide range of DoD and Industry applications. CALS is a DoD and Industry initiative to enable and accelerate the use and integration of this digital technical information for weapon system acquisition, design, manufacture, and support. The initial impetus for CALS came from industry leaders frustrated by the inability between various automated systems to communicate. Through management of the CALS program, a comprehensive strategy has been developed to transition from the current paper-intensive mode of operations to a highly automated and integrated mode, thereby substantially improving productivity and quality. Implementation of CALS has begun, and is already leading to a major impact on the way DoD and Industry conduct business.

#### OBJECTIVES AND BENEFITS

The Deputy Secretary of Defense initiated the DoD CALS program in September 1985, with the goal that new weapon systems would either acquire technical data in digital form in lieu of paper deliverables or obtain government access to contractor integrated data bases by 1990. Substantial quality improvements and cost reductions are expected, including:

- o Reduced acquisition and support costs for weapon systems programs through elimination of duplicative, manual, error-prone processes.
- o Improved quality and timeliness of technical information for support planning, procurement, training, and maintenance, as well as improved reliability and maintainability of weapon system designs through direct coupling to CAD/CAE design processes and data bases.

#### VUGRAPH 4 - WHAT IS CALS? (Continued)

Another example is the current manually oriented Air Force Tech Order system. It currently has over 150,000 active Tech Orders (TOs) which range between 100-150 pages each, with 60 percent text and 40 percent graphics.

This is a total of about 20 million pages. Each year about 2-3 million pages are revised. The current backlog is estimated to be as much as 2 million pages.

Deficiencies or problems in the current system include:

- o Up to 500 days to fully implement a routine change.
- o Cost of roughly \$1,000 per page (expected to increase to \$2,000).
- o From 1977 to 1986, 47 percent of Cause Code 1 mishaps listed inaccurate TOs as a contributing factor with resulting equipment losses of about \$86 million.
- o A single system, such as the B-1B, generates 35,000 new TOs, adding a million pages to the TO data bases.

This is not picking on the Air Force. The other services have similar problems. The Air Force has a major CALS initiative underway in this area.

## VUGRAPH 5 - WHAT IS CALS - CHANGE OVER TIME

To achieve CALS benefits, a phased strategy has been planned by a team composed of Office of the Secretary of Defense, the DoD Components, and Industry. Phase I will replace paper document transfers with digital file exchanges and begin process integration, and will be implemented between now and the early 1990s. In parallel, technology is being developed for Phase II, which involves substantial redesign changes in current processes to take advantage of a shared data base environment in the early 1990s and beyond. The main roles of DoD in both phases are: (1) to accelerate the development and test of data interchange and access standards, (2) to fund demonstrations and technology development in high-risk areas, (3) to encourage Industry investment in integrated processes by establishing contract requirements and incentives and (4) to implement CALS capabilities in DoD's own extensive automated systems.

The vugraph illustrates the islands of automation and paper flow today, the digital flow which is the objective of the first phase of CALS, and the ultimate shared data base which is the ultimate objective. This shared data base, called the integrated weapon system data base, will feature standard interfaces between design, design analysis, manufacturing process planning, and the support data base previously mentioned. A key element is the development and implementation of neutral data interchange standards which will make us hardware independent and allow the present islands of autonomy to be linked together to permit automated, rather than manual, transfer of data. The CALS initiative will permit DoD to present one interface to industry. This is essential in view of the sizable investments required. The ultimate integrated data base will have both product and support data. We are already well on the way to an integrated support data base since it will be an outgrowth of the current LSA Data Base. Incidentally we are not talking one massive data base. The emphasis is on connectivity of many data bases.

## VUGRAPH 6 - SCOPE

Automation and digitization is being applied to many functional areas. This vugraph shows the major areas which CALS will address.

CALS encompasses the generation, access, management, maintenance, and distribution of technical data in digital form for the acquisition, design, manufacture, and support processes. Within CALS, the common thread is technical data which includes engineering drawings, product definition and logistic support analysis data, technical manuals (TMs), training materials, technical plans, reports and operational feedback data associated with weapon systems, equipment and ships. Each of the above four segments of the CALS strategy cited relate to technical data in one or more processes. Since the logistics support analysis data can provide maintenance plans; provisioning data; support equipment requirements documents; calibration measurement recommendation data; and packaging, handling, and storage, and transportation data and feed into TMs and training materials, CALS will essentially encompass the ILS elements.

A third major area of CALS focus is on the integration of the CAD/CAE/CAM/CALS processes, particularly from an R&M and supportability viewpoint. This will enable earlier R, M and S influence on design. Since R&M is frequently responsible for as much as 30 percent of life Cycle Cost (LCC), CALS will help achieve our long desired goal of greater R, M and S design influence, which benefits in lower LCC and/or improved readiness.

#### VUGRAPH 7 - BENEFITS - SUMMARY

Can CALS reduce our dependency on paper and improve readiness and reduce life cycle costs and development time? Numerous studies and examples indicate the answer is yes. This chart illustrates some of the projected benefits predicted by experts in various studies to date.

VUGRAPH 8 - BENEFITS - ILS

This chart shows the projected savings in labor and time for ILS management and some of the ILS elements for a typical aerospace weapon system for the first seven years of program life. The time saving should contribute to improved initial operational readiness.

## VUGRAPH 9 - BENEFITS - F-16

This vugraph shows a more specific example of potential savings in storage and distribution costs of technical orders for the AF F-16. Over the next five years, as the sales of optical discs and disc players increase, costs will decrease at a marked rate. The chart compares costs for four major storage and distribution methods: paper, removable cartridges, Computer Disc-Read Only Memory (CD-ROM) and Write Once-Read Many Times (WORM) optical discs.

As optical disc technology matures, the number of optical discs required to store a suite of Tech Orders for the F-16 will diminish from twelve optical discs to three optical discs and the unit cost per disc will further decrease from approximately \$400 to \$100. The combination of these two factors will reduce costs by a factor of 10, that is to about \$492 by 1995.

This example also illustrates that potential CALS benefits depend on the pace of technology development. We will talk more about this later.

## VUGRAPH 10 - TIME SAVING CONCURRENCY

Our last benefits chart again illustrates time-reduction possibilities as CALS technology is implemented over time.

The integration of R&M with design is a major CALS initiative which depends on interfacing automated tools with both product data and operational feedback data to affect new design. A joint DoD/Industry work group has evaluated technical and management approaches to this problem, and published recommendations for DoD implementation. The key objectives are a subset of the larger concern for designing quality into new products. Coordination of R&D projects is being accomplished through a joint DoD/Industry study of "Concurrent Engineering" sponsored by OSD and hosted by the Institute for Defense Analyses. Recommendations are due by December 1988.

## VUGRAPH 11 - CALS STRATEGY

I said to achieve CALS benefits, a two phased CALS strategy has been established. The main segments in both phases are:

- o Standards. Accelerate the development and testing of standards for digital technical data interchange and integrated data base access,
- o Technology Development and Demonstration. Sponsor technology development and demonstrations in high-risk areas for integration of technical data and processes,
- o Weapon System Contracts and Incentives. Implement CALS standards in weapon system contracts and encourage Industry modernization and integration,
- o DoD Systems. Implement CALS standards and integration requirements in DoD planning and infrastructure modernization programs.

Progress in each area will synergistically foster progress in the other areas, with the technology development and demonstration and the standards driving progress. This approach will enable DoD to present a unified DoD interface to industry, and should result in lower front end costs in implementation both in industry and within the DoD infrastructure.

## VUGRAPH 12 - PHASED IMPLEMENTATION

This chart highlights key areas of interest in each phase of CALS implementation.

The first stage of transition in CALS is to convert that paper flow to a flow of digital files (a digital field exchange). At the same time we will begin to integrate the islands of automation within industry and within DoD, and thereby eliminate some of the redundant duplicative steps that are built into our current processes. Today we tend to buy the same piece of information many times over, i.e., create it, repeatedly store it in many different locations, and the result, in addition to added expense, is problems in the quality of data. Getting rid of paper is relatively easy to do. The interchange of technical data without resorting to paper products will result in increased accuracy and timeliness of data transfer at reduced costs.

Longer term objectives of CALS are (1) to obtain better product data and (2) get a shared data base environment where we open up the path for authorized government access to industry technical data bases and replace many of today's contract deliverable data products with on-line access.

The technology for Phase II of CALS is in an R&D stage at present, so we are bringing Phase II along in parallel with implementation of Phase I. Improved product data means improved digital procurement data packages in the form of 3-D product models. This will have a host of benefits. Other expected benefits from Phase II include:

- a. More complete integration than is possible in Phase I of contractor design, manufacturing, and support data systems based on advanced product data models

- b. Near real-time updates of technical data to match weapon system configuration

VUGRAPH 12 - PHASED IMPLEMENTATION (Continued)

c. On-line access by government users to distributed contractor and government data bases

d. Data bases owned by DoD, but possessed and maintained either by DoD or by contractors

e. Automated technical manual authoring and delivery

f. Automated interfaces of spares procurement with flexible manufacturing systems

g. Integration of R&M engineering as an on-line part of the CAD/CAE design process

### VUGRAPH 13 - MANAGEMENT STRUCTURE

A effort of CALS magnitude obviously has numerous management interfaces.

The DoD CALS Steering Group serves as the corporate board of directors" in formulating CALS policy and implementing the CALS program within DOD. It is chaired by the Assistant Deputy Assistant Secretary Defense (Systems) and composed of senior representatives from each of the Military Departments, Defense Logistics Agency, and key DoD participants within the Office of the Secretary of Defense. The group meets monthly. Working groups facilitate the coordination process. The National Bureau of Standards has been supporting CALS with about \$3M in effort annually.

The Industry Steering Group shown on the chart coordinates activities within the CALS Industry Task Force, which is hosted by the National Security Industrial Association (NSIA), and includes membership from the Aerospace Industries Association (AIA), the Electronic Industries Association ((EIA), the National Computer Graphics Association (NCGA), Society of Logistics Engineers (SOLE), Institute of Cost Analysis (ICA), the Shipbuilders Council of America (SCA), and others.

## VUGRAPH 14 - INDUSTRY AS A PARTNER

Industry Involvement. Substantial Industry momentum and enthusiasm have been generated for CALS, and DoD-Industry cooperation has been exemplary. Industry advocates have used DoD's commitment to CALS to gain internal management backing for investments in automation and integration of diverse processes. A voluntary CALS Industry Work Force has attracted over 400 members who have been extremely active in developing and coordinating CALS standards, defining integration requirements and addressing acquisition issues. Last year this group expended some 75 man years in support of CALS. The Industry Working Group currently has active committees in the areas of design integration, security, digital information transfers, acquisition, education/public communications, and international.

There are a lot of reasons for industry's attitude. CALS has enormous significance to commercial industry as well as the defense industry. Commercial industry is also burdened with paper. A recent article stated that there are two full sized 6 drawer file cabinets for each worker in the commercial sector. Industry sees CALS as an essential step in the drive to stay competitive. Ultimately the commercial investment will be far greater than that of the defense industry which in turn will be far greater than the DoD investment.

Ultimately major defense contractors will have such interfaces with other primes, their subcontractors, and vendors. This will be feasible with the increased capabilities of personnel computers.

Most recently, Industry has formed an Industry funded cooperative to accelerate the development of the Product Data Exchange Specification (PDES) which is the heart of Phase II CALS. A Government PDES Users Group has been established under the DoD CALS Steering Group to interface with the cooperative. PDES will be a 3-D model description providing all needed information on product functional characteristics, topology, geometry, tolerance, form feature,

VUGRAPH 14 - INDUSTRY AS A PARTNER (Continued)

assembly, manufacturing processes, and quality control. PDES is a key to better and earlier breakout and to programs such as RAMP, RAPID Acquisition of Manufactured Parts, a Navy program. This capability will contribute significantly to the disappearing manufacturing source problem, which frequently occurs as the inventory life of weapon systems continues to increase to 20 and 40 years. For example the B-52s are older than any of the pilots. The users group has representation from DoD, National Aeronautics and Space Administration, Department of Energy, and Department of Commerce/National Bureau of Standards. The head of the group is from commercial industry. This illustrates industry's recognition of CALS potential.

In addition to the support being provided through the Industry Steering Group and Task Force, individual companies are now incorporating CALS into their internal system integration and modernization efforts.

## VUGRAPH 15 - FUNDING

DoD and Industry are already making upgrades to their ADP and infrastructure capability. By leveraging these investments, CALS offers an unprecedented opportunity to influence both DoD and Industry business processes for the next five to fifteen years.

This table shows the actual and projected CALS funding established in FY 87/88. These numbers have changed in FY89 since 3 large infrastructure projects have been removed from CALS oversight.

The DoD budget for CALS in fiscal year 1989 now totals \$120 million. It includes two major categories of CALS projects:

- o New technology and infrastructure projects initiated directly in response to CALS to facilitate digital data interchange and integration. Program funding of \$45 million includes:
  - The OSD program for developing and testing CALS standards and demonstrating digital data integration, access, and delivery.
  - Initiation of the design phase and a test bed activities for the Army CALS system which will provide digital interfaces to Industry and integrate current Army islands of automation.
  - Air Force CALS system integration designs.
- o Ongoing technology and infrastructure system modernization efforts which have been put under the CALS Steering Group oversight and directly support CALS objectives. Program funding of \$75 million includes:

## VUGRAPH 15 - FUNDING (Continued)

- Technology programs which will demonstrate potential solutions to CALS problems in product definition, electronic technical manuals, reliability and maintainability integration, or parts data access (\$51 million).
- Infrastructure systems to automate engineering drawing repositories, other product data systems and automated publishing and technical manual management systems (\$24 million). These systems have made commitments to incorporate CALS interchange standards.

Under the CALS Steering Group, technology and infrastructure system modernization programs are being coordinated to get a maximum return from the DoD investment. The CALS investment is enabling data interchange and access among contractor teams, as well as interchange between contractors and DoD. Thus, the CALS projects are leveraging both the multi-billion dollar DoD plans in overall infrastructure modernization and an even larger investment by Industry in their information and automation systems.

The CALS program strategy is encouraging Industry investments in integrated processes on a productivity basis to meet design, manufacturing and data generation requirements and to respond to specific weapon system modernization programs. Incentives to accelerate Industry modernization include CALS requirements in competitive weapons system acquisitions and government funding for the Independent Research and Development (IR&D) and the Industrial Modernization Improvement Program (IMIP).

## VUGRAPH 16 - MAJOR MILESTONES

This next vu-graph is too busy to be read in detail by an audience of this size. An expanded version of this chart is in the report to Congress. The chart summarizes some of the key milestones in the four major areas of standards, technology development and demonstration, weapon system contracts and incentives, and the internal DoD Architecture and Infrastructure Modernization. Two key near term management actions are completion of the CALS Master Plan this fall, and the CALS Technology Plan late this year or early next year. We will cover each of these areas in more detail later.

## VUGRAPH 17 - APPLICATION POLICY

We are now going to discuss some aspects of CALS particularly germane to individuals in, or about to be in, major systems and major equipment program offices.

Policy guidance issued by the Deputy Secretary of Defense in August 1988 requires that:

- o Systems and major equipments now in full scale development or initial production be reviewed for opportunities to improve quality or reduce costs by changing to digital delivery or access.
- o Systems and major equipments entering development after September 1988 obtain competitive proposals for contractor integration, on-line government access to data, and digital data interchange.
- o DoD Components program resources for automated systems to receive, store, distribute, and use digital data for weapon system and logistic support.
- o The Under Secretary of Defense (Acquisition) issue further guidance on contract requirements, application to subcontractors and small business incentives and funding mechanisms.

In practical terms, the first two points state that OSD will not force backfitting on systems now in FSD or initial production, but programs entering development after September 1988 will be expected to implement appropriate CALS efforts.

The third bullet addresses infrastructure implementation, and the fourth point addresses various procurement aspects. We will address various contract issues later in the presentation.

## VUGRAPH 18 -IMPLEMENTATION GUIDE

A key document for program office personnel is the draft CALS Implementation Guide. This was released in April 1988 for coordination. The initial version is expected to be published in December 1988.

This handbook provides guidance to acquisition managers who have responsibility for preparing contract requirements addressing (1) digital delivery or access to weapons system technical information, and (2) functional requirements for integration of contractor processes that create and use technical information. This includes:

- o A description of the integrated, shared data environment toward which CALS is targeted, and guidance on the contractor proposals and plans for creating and using such an environment that should be required by the government.
- o Generic guidance, which is then tailored by application area, addressing the acquisition of digital data. In any application area there are a number of issues -- policy, technology acquisition phase and status, data use -- that must be considered in determining whether to buy data products or data access, the appropriate data form, the relevant standards and specifications, and the delivery or access mode. The application areas addressed in the Phase I.1 release of MIL-HDBK-CALS include:
  - Technical manuals
  - Technical data packages, including engineering drawings, specifications, and book-form drawings
  - Logistic support analysis record data
  - Training materials

## VUGRAPH 18 -IMPLEMENTATION GUIDE (Continued)

- o Guidance on delivery or access mode requirements, such as magnetic tape physical media for data delivery, and Defense Data Network/Open System Interconnection compatibility for online access.
- o Functional requirements for integration of contractor processes, with an initial focus on improvements in early reliability and maintainability (R&M) design influence through integration of R&M with computer-aided design and engineering (CAD/CAE). Instructions to offerors would require contractor proposals, which would be given significant emphasis during source selection and then contractually required.
- o Discussion of data base and telecommunication security considerations, data rights in a digital environment, and related acquisition issues.

The handbook is explicit in terms of current limitations. For example, today's computers generally still handle textual data quite differently from graphics, and this causes difficulty in producing and maintaining integrated narrative and illustrative material in technical manuals. The guide will be expanded to cover additional functions as part of the planned incremental releases of the CALS standards and specifications.

The key word is guide. It should be used to assist in determination of specific contract requirements. It should not be invoked blindly. This guide will obviously be updated as CALS evolves and experience gained, but, the present draft is an excellent starting point.

## VUGRAPH 19 - DECISION TEMPLATE

This vugraph shows the master decision template contained in the guide for systematic determination of how product data should be delivered to the government by the contractor. The decision points on the template are not always exclusive and indicate a range of alternatives open to the Acquisition Manager. That is, selecting one option at a decision point for a particular data product does not necessarily prohibit the selection of other options for that same or other data products. On each weapon system program, the delivery media and technical use for each data product contract line item and CDRL item must be carefully evaluated. That evaluation process involves making four sets of decisions as shown in the template. The handbook tailors the master template shown for the following subjects: technical manuals, engineering drawings, specifications and standards, the LSAR, and training products. It provides guidance for each subject such as intended data use, life cycle phase, delivery costs, and available technology.

## VUGRAPH 20 - WEAPON SYSTEM CONTRACT - 1990s

This chart shows major CALS requirements for weapon system and major equipment contracts in the 90s. The contractor will be expected to describe his planned CALS effort in detail in his proposal.

CALS should be a factor in the DoD source selection criteria. Plans should include subcontractor coverage and other issues such as data rights, security, etc. The RFP should provide government plans for furnishing GFI in digital terms (if possible). Information should be available concerning government receiving systems capabilities.

The last two bullets address the specific functional capabilities and the type of logistics data products on which paperless delivery will be emphasized. The importance of these functional capabilities can be illustrated by fact that 30 percent of the life cycle cost can be directly traced to the R&M characteristics of the design. All of these requirements are not necessarily needed on an individual program. Functional capabilities are far more important on a major new design than a systems integration effort or NDI modification.

The movement toward functional requirements integration will ultimately result in such capabilities as:

- o Automated generation of design alternatives
- o Online access to prior designs
  - Drawings and specifications
  - Engineering changes
  - Production experience
  - Field reliability and maintainability data
- o Algorithms relating design parameters to R&M, producibility

VUGRAPH 20 - WEAPON SYSTEM CONTRACT - 1990s (Continued)

- o Integration of automated engineering analyses
  - Testability design and fault tree analysis
  - Reliability analysis and prediction
  - Finite element modeling
  - Thermal analysis
  - Development of maintenance requirements
- o Simulation of the design in maintenance environs
  - Access, clearances, human factors
- o Online manufacturing process planning and simulation

## VUGRAPH 21 AND 22 - CALS MAJOR THRUSTS - WHERE ARE WE GOING

The next two charts show some of the major thrusts on delivery and the evolution of requirements over time. Product definition data and technical manuals are the most expensive support products we buy. At one time, for example, the TM department was the largest department at McDonnell, St. Louis. The LSAR, although expensive, is cheaper than other alternatives, and currently provides data for most of the current ILS elements. In short, CALS takes aim at the more expensive ILS products. Much of the integrated data dictionary and automated tech manual processes exist today.

Note the possibilities for contractor maintained data bases, and on-line review and approval. On-line transmission of the full volume of technical data for major weapon systems is beyond the economical capability of current communication networks in DoD and industry. In the near term, CALS will accomplish bulk data transfers of engineering drawings, technical manuals and other voluminous documents via physical media, such as tape or optical disk. Many DoD acquisition centers are now planning to receive the LSAR master files on tape and run their own output reports. On-line interaction will be used primarily for lower volume transaction processing and data base access where operational requirements dictate and it is economically prudent.

The long range plan is to employ cost effective, secure high speed data communication network capabilities (both commercial and Defense Data Network upgrades) which are expected to be available in the future. Studies are underway to identify the most effective and efficient means for digital data transmission and communication.

However, on-line review, with reduction of time on-site by DoD review teams, will become more and more practical as CALS grows, since more and more of the data for review can be available digitally and communication costs will decrease.

### VUGRAPH 23 - IMPORTANT IMPLEMENTATION CONSIDERATIONS

While the goals for progress are obviously ambitious, the OSD does recognize that implementation is a difficult process. This vugraph summarizes the remarks of Dr. Michael McGrath, Director of the OSD CALS Policy Office, made to the CALS EXPO 88 early in October 1988. The points on the vugraph illustrate that while OSD is aggressively pushing CALS, it also wants you to be realistic in application to defense contracts.

## VUGRAPH 24 - WEAPON PROGRAM EXAMPLES

Several programs have already begun trial application of CALS technologies and integration approaches. CALS pilot programs include the A-12, ATF, and LHX aircraft (coordinated under the Joint Logistics Commanders), the SSN-21 submarine, and the V-22 aircraft. These programs provide demonstrations of data integration, on-line government access to contractor maintained data bases and digital data interchange, as discussed in Appendix C. Successfully demonstrated approaches will be used on these programs and others in the early to mid 1990's. Additional, nearer term, CALS applications are being planned on such programs as Joint Tactical Fusion, the Mine Countermeasures ship, and the B-2 bomber. More near term applications are being considered. The experience gained in these programs will significantly influence future routine contractual implementation of CALS. The paper in your handouts is an excellent example of the early kinds of effort required to achieve CALS objectives.

## VUGRAPH 25 - V-22 CALS DEMONSTRATIONS

This chart illustrates in more detail the various areas being demonstrated on the V-22 OSPREY aircraft.

The project on feedback of operational data will establish interconnection between government and contractor data bases. It will develop a system to better utilize data such as 3M, safety, engineering investigations, and quality deficiency reports to help quantitatively substantiate the need for improved engineering and logistics design.

## VUGRAPH 26 - GROWTH IN BENEFITS

This chart conceptually summarizes several key points. The first is the interaction and the continuing evolution of CALS due to progress in the standards, technology demonstrations, etc.

The second is the increasing growth of the benefits in terms of dollars, time, or readiness over time to DoD programs as technology and implementation matures.

## VUGRAPH 27 - TECHNICAL ASPECTS

The next few charts will briefly summarize some of the technical aspects of the program. Needless to say, these aspects are the heart of the CALS effort since they will provide the common interface needed for industry and DoD to effectively interchange and use digital data.

A brief word about the specifications and standards before we get into the detail. The standards involved will go through a maturation period. For example the IGES specification, for graphics exchange, and the specification used on the SSN-21 program, first issued in 1980, has had five updates before its content was frozen. Thus the benefits from these documents will increase both because of document improvement as well as wider application.

The Air Force AFTOMS Automation Plan, a copy of which is in the library, has excellent discussions of the expected technology improvements in areas such as automated reading of paper documents, mass storage, computer based printing, and hypertext and videodisc systems.

## VUGRAPH 28 - INITIAL CALS STANDARDS

The CALS standards and specifications are being developed incrementally. The initial increment, called the Phase 1.0 Core Requirements package, was developed and coordinated during 1987. The 1988 increment, called the Phase 1.1 Core Requirements Package, has been released for formal DoD and industry coordination and will be published by December. Development of the Phase 1.2 standards and specifications is underway for coordination during 1989. Documents released to date include:

MIL-STD-1840A, "Automated Interchange of Technical Information." MIL-STD-1840A is the parent document for the other CALS standards and specifications. It provides rules for organizing files of digital data into a complete deliverable document, using the supporting CALS military specifications -- MIL-D-28000 for IGES product definition data, MIL-M-28001 for SGML text data, MIL-D-CGM for vector illustration data, or MIL-R-RASTER for Raster illustration data.

MIL-D-28000, "Digital Representation for Communication of Product Data: IGES Application Subsets." MIL-D-28000 defines a series of application-specific subsets of the Initial Graphics Exchange Specification (IGES), the popular name for American National Standard ANSI Y14.26M, "Digital Representation for Communication of Product Definition Data."

MIL-M-28001, "Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text." MIL-M-28001 defines standard DoD requirements for automated publishing of page-oriented (i.e., printed) technical manuals and technical orders. It defines a common DoD-wide implementation of

## VUGRAPH 28 - INITIAL CALS STANDARDS (Continued)

International Standard ISO 8879, "Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML)." It also defines typographic tags and format rules for document composition, and options for use of commercial page description language products.

MIL-D-CGM, "Digital Representation for Communication of Illustration Data: CGM Application Profile." MIL-D-CGM defines an application profile for delivery of technical manual illustration using the Computer Graphics Metafile (CGM). CGM has been published as International Standard ISO 8632, American National Standard ANSI X3.122, and Federal Information Processing Standard FPS 128.

MIL-R-RASTER, "Requirements for Raster Graphics Representation in Binary Format." MIL-R-RASTER defines engineering drawing and technical manual illustration requirements for Raster graphics compressed in accordance with International Standard CCITT T.6, "Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus," and FED-STD-1065.

## VUGRAPH 29 - STANDARDS IN DEVELOPMENT

This chart shows examples of work now underway to define CALS Phase 1.2 and Phase II Core Requirements to broaden the application environment for the current CALS standards, and in selected cases define requirements for additional digital data interchange and access standards. Examples include:

- o The Office Document Architecture and Interchange Format (ODA/ODIF) for presentation and layout, and the Standard Page Description Language (SPDL) for image delivery, of technical publications
- o Various additional candidates for exchange for product definition data for electronics, such as the Electronic Data Interchange Format (EDIF), the VHSIC Hardware Description Language (VHDL), and the Integrated Printed Circuit (IPC) standards
- o The Information Resource Dictionary System (IRDS) for management of data element definitions and their relationships, and the Structured Query Language (SQL) for data access
- o The Product Data Exchange Specification (PDES) which will encompass the complete set of data elements that defines a product for all applications over its expected life cycle

The work to develop CALS implementations of these current and future industry standards is being accomplished jointly by DoD, National Bureau of Standards (NBS), and by industry users and vendors.

## VUGRAPH 30 - TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS

To further illustrate the magnitude of the CALS technical efforts, the next two charts show the number of such projects and the year of expected initial results. The individual projects are described in the appendices of the CALS report to Congress. Some copies of this report are available if you desire one.

The projects cited are representative rather than all-inclusive, since assignment of projects as part of CALS or other automation projects can change from year to year. These projects represent candidate CALS technical approaches or standards, are providing early experience using CALS product data standards, or are involved in the identification of data requirements and interfaces.

The Navy Mine Countermeasures Ship (MCM) project, for example, is developing specifications for product modeling which includes a 3D graphical solid presentation integrated with other logistics and analytic files to provide a complete integrated data set.

The DLA Government Furnished Baseline (GFB) project will provide a prototype capability for industry and military activities direct access to the DLA electronic and mechanical parts data bases.

The 1988 DLA CALS Program Implementation Plan, a copy of which is in the library, has an excellent discussion of all the DLA CALS related projects.

### VUGRAPH 31 - CALS ARCHITECTURE AND INFRASTRUCTURE IMPLEMENTATION

This chart shows the number of projects and timing of projects associated with CALS architecture and infrastructure implementation. Again they are each described in your handout. Note the heavy activity in engineering data repositories and product data and automated publishing and paperless TM systems.

One of the questions frequently raised is - can benefits be obtained by eliminating duplication between some of these projects? This question is being addressed.

During the last year, OSD had led the components in a series of planning sessions to more clearly define the scope of CALS and coordinate on-going problems. Planning sessions over the next year will continue to define areas where corporate DoD solutions are needed as distinguished from those where Component-specific solutions are appropriate. To support this effort, a top level functional review of each Components programs and processes that relate to CALS has begun, using a formalized systems architecture development approach. This approach will define corporate elements of the CALS "system of systems" in terms of the required data, the functions, and the network architecture. Architectural guidelines based on this structured approach will be available in June 1989, and will address elements critical to CALS Phase II, such as the indexing and locator system for accessing data in a highly integrated, but geographically distributed, data base environment. These elements will be corporately developed to insure consistent CALS implementation within DoD and Industry.

The final point to be made on the last two charts is timing. While the year cited for each project normally represents initial results, most of these projects fall in the near time frame. Thus many of these projects, could impact systems and major programs now in concept formulation or advanced development.

## VUGRAPH 32 - CALS STANDARDS IMPLEMENTATION STEPS

Many of you may have had some past experiences attempting to transfer data which could lead to questioning the efficacy of such data transfer. For example several years ago, I was totally frustrated when I tried to transfer a DECMATE disc to a WANG disc. I finally resorted to a scanner which still required a fair amount of rework. This year we more successfully used a WANG conversion program, but we still lost the word processing format control functions.

Good standards are key to making CALS effective. At least one expert believes testing represents 25% of the effort to get a good data interchange standard. Agreement on a specification is only 25% toward a workable standard. In recognition of this a major testing effort is underway.

The National Bureau of Standards is developing the necessary conformance tests needed to evaluate vendor compliance with CALS Standards as they are published. However, conformance tests are only the first level of testing required to assure that digital data exchange standards adequately support user requirements for end-to-end data transfer and provide the necessary feedback for standards update. As testing and trial implementation takes place, planning for DoD and Industry infrastructure modernization continues. The sequence of the steps for implementation of standards is illustrated in the vu-graph.

OSD has designated the Air Force as lead service in creating a DoD and Industry distributed test bed network for comprehensive testing of the CALS standards in user applications. By linking existing nodes in DoD and Industry, the investment in the network will be minimized. One such node is the Army CALS test bed, which was

VUGRAPH 32 - CALS STANDARDS IMPLEMENTATION STEPS (Continued)

published in its initial evaluation of vendor tools to support the CALS standards. The CALS test network will establish a data base of evaluation results and a corrective action review board to follow up on recommendations for improved standards and vendor implementation. Testing of use effectiveness between contractors and DoD Components will also be accomplished when digital data exchange is made in lieu of hard copy transmission of technical data. A test plan identifying test participants, testing scope and schedules will be available in July 1988 when initial testing of data exchange standards begins.

Through testing, trial contractual applications, and technology development and demonstration, CALS will ensure that its implementations of national and international standards fully meet the needs of DoD and the defense industry.

## VUGRAPH 33 - ISSUES

### Rights To Data

Not much different than rights in data now.

### Security, Privacy, Export Controls

These subjects are not the same.

There are technical approaches available to enhance security, but the human problems will still exist. There are a number of practical issues to be addressed in specific program application. The draft implementation guide has a good discussion on this.

### Profit Structure, Investment Precautions

#### - Profit

- o Big differences here.
- o Contractors price now with assumption that they will have sole source support (spares, etc.) for 3 to 5 years - nothing wrong with this - its simply a pricing strategy.
- o CALS will probably allow earlier breakout - so industry will tend to price higher in the earlier time periods.

#### - IR&D

- o We plan to initiate higher grades for CALS related IR&D.

### Source Selection

We are pushing to make CALS a significant consideration for source selection. The draft handbook contains an approach and suggested RFP language in terms of R&M integration with CAD/CAE.

## VUGRAPH 33 - ISSUES (Continued)

### Delivery, Verification, Acceptance

Primarily a government problem. What happens to the DD 250? We will have an electronic signature much like the computer retina scan used in STARTREK. Not a major problem.

### Legal Liability

Not really much different here - although an industry concern that they would be liable for issuance of a T.O. originating from an organic initiated change which caused an accident. Most government program managers run organic changes by the contractor.

### Cooperative Production (other nations)

Will be a problem. CALS standards will have to be adopted by other nations. This will probably take a long time.

### DAR, FAR Revisions

Some changes will be needed since they are currently written for the paper world.

### ADP Acquisition Revision

Won't be much change since this is still basically controlled by Congressman Brooks.

#### VUGRAPHS 34 - SUMMARY - BENEFITS

This chart summarizes the benefits from CALS for both DoD and Industry. There is no doubt that CALS will make a significant contribution to increasing the competitiveness of both the defense and commercial industry.

DoD will experience productivity gains, but more importantly CALS will improve readiness and shorten lead times. Ultimately CALS will also result in designed in R&M improvements and better configuration management, a frequent problem today, particularly in older systems.

## VUGRAPH 35 - CONCLUSION

This vu-graph concludes the presentation. CALS will shortly be a major consideration in most DoD major system and acquisition programs. CALS is an evolving effort which has the support of OSD, the military department, the JLC, and industry. CALS is here to stay. The guidance and capabilities are improving rapidly over time. A list of key contacts is among your enclosures to assist you in obtaining the most recent developments and information.

I'd be happy to answer any questions.

END

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